



Research Paper

Study on variability in field experiments of wheat (Bhal and coastal zone) crop and yardstick

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ABSTRACT : The data on C.V. per cent for wheat (Bhal and coastal zone) crop yield along with other details of 374 field experiments conducted during 1989-90 to 2014-15 at Agriculture Research Station, Anand Agricultural University, Arnej and Dhandhuka centre were collected and analyzed. The frequency distribution tables were prepared for various experimental factors. The upper fiducial limits (the yardstick) of C.V. per cent at 95 per cent confidence based on non-central 't' distribution were worked out for accepting the results of wheat (Bhal and coastal zone) crop experiments which emerged as 15 per cent.

KEY WORDS : CV per cent, Fiducial limit, Plot size, Non-central t distribution, Experimental variability

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INTRODUCTION :

In agricultural field experiments variation occurs due to uncontrolled factors such as soil fertility, climatic factors etc. and controlled factors such as field layout, treatments, replications, plot size etc. Such factors play an important role in the precision of the experimental results. C.V. per cent of the experiment is considered as a reliable index of variability for accepting or rejecting experimental results. Study on variability of large number of experiments help to develop the yardstick of CV per cent for field experiments. The present investigation was carried out with the objectives to study the experimental factors viz., disciplines, design, replications, treatments and plot sizes responsible for variability and to develop yardstick for reliability of the experimental results of wheat (Bhal and coastal zone) crop experiments.

MATERIALS AND METHODS :

The secondary data on C.V. per cent medicinal and aromatic crop yield of 374 field experiments conducted at Agriculture Research Station, Anand Agricultural University, Arnej and Dhandhuka centre during 1989-90 to 2014-15 in plant breeding, agronomy and soil science disciplines on different wheat (Bhal and coastal zone) crop were utilized for the variability study. Information on plot size, number of treatments, replications, experimental design and disciplines was collected for each experiment. The data were analyzed to estimate error mean square and thereby C.V. per cent of each experiment (Snedecor and Cochran, 1967). Tyagi *et al.*, 1973 and Patel *et al.*, 1978) pointed out that C.V. obtained for the crops under study was found to be considerably higher than those reported from the uniformity trials. They stated that the yardstick for accepting experimental results should be worked out using C.V. observed in the

experiments rather than in the uniformity trials. Bajpai and Nigam suggested a working rule for deciding the value of W_2 (weight corresponds to precision of the experiments) and developed an index to evaluate agricultural field experiments statistically. Gomez and Gomez (1984) reported that C.V. varies greatly with the type of experiment, the crop grown and the character measured. They pointed that the acceptable range of C.V. is 6 per cent to 8 per cent for varietal trial, 10 to 12 per cent for fertilizer trials and 13 to 15 per cent for insecticidal and herbicidal trials on rice. The upper fiducial limit of C.V. per cent at 95 per cent confidence level based on non central 't' distribution (Johnson and Welch, 1939) was worked out on the basis of overall average C.V. per cent of 374 experiments in the present study, which was considered as yardstick of C.V. per cent for field experimentation on wheat (Bhal and coastal zone) crop.

RESULTS AND DATA ANALYSIS :

The results presented in Table 1 revealed that mean

C.V. per cent (11.74) and upper fiducial limit (14.10) of average value of all the discipline except for agronomy discipline, were below the mean C.V. per cent. The experiments on agronomy showed large variation (average CV = 14.51 %) showed poor precision may be because of experimental requirements such as sample size, natural population of pests and diseases. Use of proper statistical tools may help to improve the precision of the results. More than 50 per cent experiments of this disciplines had more than 14.10 per cent.

The results presented in Table 2 indicated that most of the experiments were carried out in RBD and about 23 per cent of them had C.V. per cent higher than the fiducial limit worked out. The proportion showed 0.14 to 0.40 in split plot and FRBD.

Influence of number of treatments was also examined and results are given in (Table 3) according to different treatments group. < 6, 21-25, 26-30 and > 31 treatments in an experiment showed higher C.V. per cent than the overall average (11.74 %).

Generally increased number of treatments in the

Table 1: Upper fiducial limit of CV per cent for different disciplines of wheat (Bhal and coastal zone) crop

Discipline	No.of expt.	CV %	U L		Range		CV % > 14.10	
			(0.05)	(0.10)	(0.05)	(0.10)	No.of expt.	Proportion
Agronomy	16	14.51	18.19	17.28	3.69	2.78	8	0.50
Plant breeding	345	11.61	13.90	13.35	2.29	1.74	77	0.22
Soil science	13	11.66	14.33	13.67	2.66	2.01	3	0.23
Average	374	11.74	14.10	13.53				

Table 2 : Upper fiducial limit of CV per cent for different design wheat (Bhal and coastal zone) crop

Design	No.of expt.	CV %	U L		Range		CV % > 14.10	
			(0.05)	(0.10)	(0.05)	(0.10)	No. of expt.	Proportion
FRBD	5	12.34	14.66	14.11	2.32	1.77	2	0.40
RBD	362	11.76	14.15	13.57	2.38	1.81	85	0.23
Split plot	7	10.06	11.36	11.06	1.30	1.00	1	0.14
Average	274	11.74	14.10	13.53				

Table 3 : Upper fiducial limit of CV per cent for different treatments of wheat (Bhal and coastal zone) crop

Treatments	No.of expt.	CV %	U L		Range		CV % > 14.10	
			(0.05)	(0.10)	(0.05)	(0.10)	No. of expt.	Proportion
< 6	1	19.65	31.00	27.64	11.35	7.99	1	1.00
6-10	43	10.69	13.61	12.89	2.92	2.20	9	0.20
11-15	66	11.40	13.75	13.19	2.35	1.79	15	0.22
16-20	81	10.13	12.23	11.72	2.10	1.60	15	0.18
21-25	74	12.06	14.42	13.86	2.36	1.80	20	0.27
26-30	105	13.22	15.49	14.96	2.27	1.74	26	0.25
>30	4	14.72	16.75	16.29	2.03	1.57	2	0.50
Average	374	11.74	14.10	13.53				

experiments increases blocks (replication) size which increases error variance, affecting the precision of the results. Therefore, it is advisable to use such experimental designs (when treatment exceeds 21) which can help in controlling within block variation. Other means such as optimum plot size, more number of replications, proper site of the experiment etc. need to be considered. About 25 to 50 per cent experiments showed higher C.V. per cent compared to the overall average C.V. per cent except the treatment group 6-20.

The results presented in (Table 4) indicated that the

average C.V. per cent for different plot size experiments were below the average C.V. per cent (11.74) in plot size < 3, 12-15 and 15-18 sq.mt. The average C.V. per cent for different plot size experiments were higher the average C.V. per cent (11.74) in plot size 3-6, 6-9, 9-12 and 18-21 sq.mt. The proportion of C.V. per cent having higher C.V. per cent increased from 0.25 to 0.66, therefore, plot size of 12 to 18 sq.mt. seems to be an optimum plot size for wheat (Bhai and coastal zone) crop. Therefore, this needs to be confirmed by plot technique study for different locations.

Table 4: Upper fiducial limit of CV per cent for different plot size of wheat (Bhai and coastal zone) crop

Plot size (m ²)	No. of experiment	CV %	U L		Range		CV % > 14.10	
			(0.05)	(0.10)	(0.05)	(0.10)	No. of expt.	Proportion
<3	2	9.21	10.62	10.29	1.41	1.08	0	0.00
3-6	3	17.13	20.64	19.80	3.51	2.67	1	0.33
6-9	253	12.07	14.43	13.87	2.37	1.80	63	0.25
9-12	37	11.87	14.49	13.84	2.62	1.97	10	0.27
12-15	11	10.78	13.28	12.68	2.50	1.90	2	0.18
15-18	65	10.27	12.41	11.90	2.14	1.63	10	0.15
18-21	3	14.26	16.90	16.28	2.64	2.02	2	0.66
Average	374	11.74	14.10	13.53				

Table 5: Upper fiducial limit of CV per cent for different replications of wheat (Bhai and coastal zone) crop

Replication	No. of expt.	CV %	U L		Range		CV % > 14.10	
			(0.05)	(0.10)	(0.05)	(0.10)	No. of expt.	Proportion
3	167	11.20	13.60	13.02	2.40	1.82	30	0.18
4	49	11.94	13.82	13.38	1.89	1.45	8	0.16
5	155	12.31	14.80	14.20	2.49	1.89	50	0.32
7	3	8.79	10.28	9.94	1.50	1.15	0	0.00
Average	374	11.74	14.10	13.53				

Table 6 : The average upper fiducial limit and yardstick for CV per cent for the experiments of wheat (Bhai and coastal zone) crop

Name of crop	No. of experiments	Mean CV %	Upper fiducial limit of CV %		Overall yardstick of CV%
			0.95	0.90	
Wheat (Bhai and Coastal zone) crop	374	11.74	14.10	13.53	15

Table 7 : Power of F-test as influence by CV per cent

Classes CV %	No. of experiments	F-test		Ratio
		Significant	Non-significant	
1.0-11.0	195	187	8	0.04
11.0-21.0	156	144	12	0.08
21.0-31.0	21	18	3	0.17
31.0-41.0	1	1	0	0.00
41.0-51.0	0	0	0	0.00
51.0-61.0	1	1	0	0.00
Total	374	351	23	0.07

As far as replications are concerned, the experiments conducted with 4 and 5 replications showed large variation 16 and 32 per cent experiments showed C.V. > 14.10, respectively (Table 5). Analysis showed that majority experiments were conducted with 3 and 5 replications in field experiments on wheat (Bhal and coastal zone) in which about 32 per cent were having C.V. per cent > 14.10.

Yardstick of C.V. per cent for wheat (Bhal and coastal zone) crop experiments :

The C.V. per cent data of 374 field experiments were used to fit non central 't' distribution and to work out upper confidence limit of C.V. at 0.05 level of probability. According the upper fiducial limit of C.V. per cent at 95 per cent confidence level of C.V. per cent was worked out to be 14.10 per cent (Table 6). Thus, the results suggested that about 15 per cent C.V. per cent should be considered as a yard stick for wheat (Bhal and coastal zone) crop field experiments. These having C.V. per cent > 15 should be rejected for drawing scientific conclusion.

The power of F test was examined with the non-significant/ significant ratio of experiments (Table 7). The results revealed that the ratio consistently increased with the increase in C.V. of the experiments. It also indicated that the efficiency (of detecting difference in treatment means) of F-test decreased with the increase in C.V. of experiments. The average ratio was observed to be 0.07. The ratio for the class 11.0 – 21.0 per cent was almost equal to the average ratio which included 11.74 per cent, the mean C.V. of all experiments results clearly showed that when the co-efficient of variation in wheat (Bhal and coastal zone) crop field experiments exceeds 15 per

cent, the experimental finding should not be considered for scientific purpose.

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